CLAIMS

1. An array receiver for processing signals received from a plurality of transmitting users via an array antenna having an array of *N* antenna elements (22/1, ..., 22/N) providing a set of antenna signals (x_1, x_2,..., x_N), respectively, each comprising information from each user,

characterized in that said receiver has

a common preprocessing section (40) for sampling each of the antenna element signals (x_1, x_2,..., x_N) and processing the samples of at least some of said antenna signals to form a plurality of basis signals (y_0,..., y_M) together having fewer space-time dimensions than the space-time dimensions of the combined antenna signals, and

a plurality of signal processing units (60/0, ..., 60/M) each having a plurality of inputs coupled to the common preprocessing unit (40) for receiving all of the basis signals, each processing unit processing and combining said basis signals to produce a respective one of a set of estimated received signals (z_0,..., z_M) each for a corresponding desired one of the users,

the common preprocessing section comprising

filtering means (40/0,..., 40/M) for combining all of the antenna signals (x_1, x_2,..., x_N) to provide said plurality of basis signals (y_0,..., y_M), each of the basis signals comprising a different combination of the antenna signals,

each of the signal processing units (60/0,..., 60/M) combining the basis signals to provide a user-specific output signal,

and updating means (42/m, 44/m, 46/m) for periodically updating parameters of the filtering means used for deriving each particular basis signal such that each user-specific output signal will exhibit a desired optimized concentration of energy of that desired user's received signal as received by the array antenna.

2. A receiver according to claim 1, characterized in that the updating means (42/m, 44/m, 46/m) comprises means (46/m) for adjusting said parameters in dependence upon channel characteristics of all user channels.

3. A receiver according to claim 1, characterized in that

each of the processor units (60/0,..., 60/M) comprises means (62/0,..., 64/M, 64/0,..., 64/M) for weighting the basis signals (y_0,..., y_M) before combining same, the weights (w_{00},..., w_{MM}) being adjusted in dependence upon channel characteristics of all user channels,

and the parameters of the filtering means (40/0,..., 40/M) are updated less frequently than the weights (w_{00},..., w_{MM}) of the processor units (60/0,..., 60/M).

4. A receiver according to claim 1, 2 or 3, characterized in that the number of basis signals is equal to the number of desired user signals.

5. A receiver according to claim 1, 2 or 3, characterized in that the common preprocessing means (40) comprises M+1 dominant subspace filters producing a set of basis signals $\mathbf{y}_m = [y_{m,1}, ..., y_{m,\mu}]$ where m is the index of the filter, and m = 0, 1, ..., M, said basis signals $\mathbf{y}_m$ being projections of the input signals (x_{11}, x_{12}, ..., x_{1L}, x_{21}, x_{22}, ..., x_{2L}, ..., x_{N1}, x_{N2}, ..., x_{NL}) onto the μ dimensions of the subspace occupied by signal m which carry the most energy.

6. A receiver according to claim 2, 3, 4 or 5, characterized in that the updating means (42/m, 44/m, 46/m) comprises a training sequence generator for generating a training sequence for the corresponding user,

covariance matrix estimation means responsive to the training sequence and the antenna signals for providing a covariance matrix embodying long-term statistics for the channel of that user, and

eigenvector estimation means for extracting from said covariance matrix at least the dominant eigenvector constituting said linear combination, elements of said dominant eigenvector being applied to said filtering means as weights for updating said parameters.

7. A receiver according to claim 1, characterized in that each of the plurality of filters (40/0, ..., 40/M) comprises a filter matched to a respective one of the desired users.

8. A receiver for receiving signals from a plurality of transmitting users via an array antenna having an array of N antenna elements (22/1, ..., 22/N) providing a set of antenna signals (x_1, x_2,... x_N), respectively, each comprising information from each user, said receiver

characterized by a common preprocessing section followed by a plurality of receiver sections, each corresponding to a different one of the users and coupled to the outputs of the common preprocessing section, the preprocessing section sampling each of the antenna signals (x_1, x_2,..., x_N) and processing the samples of at least some of said antenna element signals to form a plurality of basis signals (y_0,..., y_M) together having fewer space-time dimensions than the space-time dimensions of the combined antenna signals, and a plurality of signal processing units (60/0, ..., 60/M) each having a plurality of inputs coupled to the common preprocessing unit for receiving all of the basis signals, each processing unit processing and combining said basis signals to produce a respective one of a set of estimated received signals (z_0,..., z_M) each for a corresponding desired one of the users,

the common preprocessing section comprising

(i) means for maintaining through periodic updates a set of dominant subspace filters, each of which being matched to one of the users of interest, and the outputs of which being used by the subsequent receiver sections, to be processed and combined in order to yield an estimate of the desired signal for each user of interest;

(ii) means for periodically estimating and/or updating the component weights of the dominant subspace filters by correlation, with a known training sequence or with the user's spreading code in a CDMA system or with any other signal strongly correlated with the user of interest's signal, in combination with appropriate temporal averaging to isolate subspace-level information, as opposed to instantaneous channel characteristics; and

(iii) means for periodically or dynamically estimating and/or updating the component weights (and/or any other parameters of interest) of the receiver sections fed from the preprocessing section in a manner and at a rate such that instantaneous channel changes are tracked to provide a reliable and consistent estimate of the desired signal.

9. An array receiver system comprising a receiver according to any one of claims 1 to 8, in combination with a said array antenna comprising a plurality of antenna elements.

10. A method of receiving signals from a plurality of transmitting users via an array antenna having *N* antenna elements (22/1, ..., 22/N) providing a set of antenna signals (x_1, x_2,..., x_N), respectively, each comprising information from each user, the method characterized by the steps of:

sampling each of the antenna signals;

preprocessing the samples of at least some of said antenna element signals (x_1, x_2,..., x_N) to form a plurality of basis signals (y_0,..., y_M) together having fewer space-time dimensions than the space-time dimensions of the combined antenna signals,

processing and combining said basis signals (y_0,..., y_M) to produce a set of estimated received signals (z_0,..., z_M) each for a corresponding one of the users,

the preprocessing including the steps of

combining all of the antenna signals (x_1, x_2,..., x_N) to provide said plurality of basis signals (y_0,..., y_M) such that each of the basis signals comprises a different combination of the antenna signals,

the processing and combining step comprising the step of combining the basis signals (y_0,..., y_M) to provide a series of user-specific output signals,

the method further comprising the step of periodically updating parameters used for deriving each particular basis signal such that each user-specific output signal will exhibit a desired optimum concentration of energy of the received signal if that particular user as received by the array antenna.

11. A method according to claim 10, characterized in that the updating step adjusts said parameters in dependence upon channel characteristics of all user channels.

12. A method according to claim 10, characterized in that the updating step adjusts said parameters in dependence upon channel characteristics of all user channels, each step of processing the basis signals weights the basis signals before combining same, and adjusts the weights in dependence upon channel characteristics of all user channels, and wherein the parameters are updated less frequently than the weights.

13. A method according to claim 10, 11 or 12, characterized in that the number of basis signals is equal to the number of desired user signals.

14. A method according to claim 10, 11, 12 or 13, characterized in that the common preprocessing step uses M+1 dominant subspace filters to produce a set of basis signals $y_m = [y_{m,1}, \ldots, y_{m,\mu}]$ where m is the index of the filter, and m = 0, 1, ..., M, said basis signals y_m

being projections of the input signals (x_{11}, x_{12}, ..., x_{1L}, x_{21}, x_{22}, ..., x_{2L}, ..., x_{N1}, x_{N2}, ..., x_{NL}) onto the μ dimensions of the subspace occupied by signal m which carry the most energy.

15. A method according to any one of claims 10 to 14 further characterized by the step of generating a training sequence for each user, and wherein:

the updating step, responsive to the training sequence and the antenna signals, provides a covariance matrix embodying long-term statistics for the channel of that user, and

uses eigenvector estimation means for extracting from said covariance matrix at least the dominant eigenvector, elements of said dominant eigenvector being employed for updating said parameters.

16. A method according to claim 10, characterized in that the filtering step uses a plurality of filters (40/0, ..., 40/M) each matched to a respective one of the desired users.

17. A method of receiving signals from a plurality of transmitting users using an array antenna having an array of antenna elements (22/1, ..., 22/N) and a receiver comprised of a common prefiltering section followed by a plurality of receiver sections, each corresponding to a different one of the users and coupled to the outputs of the common prefiltering section, the method characterized by the steps of

(i) maintaining through periodic updates a set of dominant subspace filters, each matched to one of the users of interest, and the outputs of which being used by the subsequent receiver sections, to be processed and combined in order to yield an estimate of the desired signal for each user of interest;

(ii) periodically estimating and/or updating the component weights of the dominant subspace filters by correlation with at least one of (a) a known training sequence, (b) the user's spreading code where the method is used in a CDMA system, and (c) any other signal strongly correlated with the signal of the user of interest, in combination with appropriate temporal averaging to isolate subspace-level information, as opposed to instantaneous channel characteristics; and

(iii) periodically or dynamically estimating and/or updating the component weights (and/or any other parameters of interest) of the receiver sections fed from the prefiltering

section in a manner and at a rate such that instantaneous channel changes are tracked to provide a reliable and consistent estimate of the desired signal.